Check List the journal of biodiversity data

NOTES ON GEOGRAPHIC DISTRIBUTION

Check List 16 (6): 1575–1580
https://doi.org/10.15560/16.6.1575

PENSOFT

New occurrence records of Bromeliaceae for the state of Maranhão, northeastern Brazil

Elidio A. E. Guarçoni[1], Jeferson D. S. Sousa[1], Alessandro W. C. Ferreira[2], Wagner R. S. Junior[2], Miguel S. Oliveira[3], Eduardo O. Silva[4]

1 Maranhão Continental Herbarium, Federal University of Maranhão, Coordination of Natural Sciences Biology, Bacabal Campus, Av. Governador João Alberto, s/n, Bambu, CEP 65700-000, Bacabal, MA, Brazil. **2** Federal University of Maranhão, Department of Biology, University City Dom Delgado, Av. dos Portugueses, 1966, Bacanga, CEP 65080-805, São Luís, MA, Brazil. **3** State University of Maranhão, Department of Chemistry and Biology, Praça Duque de Caxias, s/n, Morro do Alecrim, CEP 65604-090, Caxias, MA, Brazil. **4** Federal University of Maranhão, Coordination of Natural Sciences, Codó Campus, Av. Dr. José Anselmo, 2008, São Benedito, CEP 65.400-000, Codó, MA, Brazil.
Corresponding author: Elidio A. E. Guarçoni, elidio.guarconi@ufma.br

Abstract

We report three species of Bromeliaceae (*Encholirium spectabile* Mart. ex Schult. & Schult.f., *Pitcairnia burchellii* Mez, and *Tillandsia bulbosa* Hook.) for the first time from Maranhão, northeastern Brazil, based on our fieldwork. Data on species' morphology, taxonomy, ecology, and geographic distribution are included. Our new data add to the knowledge to the flora of Maranhão and expand the distribution of three bromeliad species in Brazil.

Keywords

Encholirium spectabile, geographic distribution, *Pitcairnia burchellii*, taxonomy, *Tillandsia bulbosa*

Academic editor: Ana Carolina Mezzonato-Pires | Received 8 July 2020 | Accepted 29 October 2020 | Published 18 November 2020

Citation: Guarçoni EAE, Sousa JDS, Ferreira AWC, Junior WRS, Oliveira MS, Silva EO (2020) New occurrence records of Bromeliaceae for the state of Maranhão, northeastern Brazil. Check List 16 (6): 1575–1580. https://doi.org/10.15560/16.6.1575

Introduction

Biogeography is the study of the distribution of living beings in space and time, and distribution patterns can be used to propose hypotheses on the processes of biotic regionalization around the world (Carvalho and Almeida 2016). Biogeographic data are needed for the effective conservation measures of species in natural environments and also provide important biological information (Primack and Rodrigues 2001).

The state of Maranhão, in northeastern Brazil, has a large area (IBGE 2017) occupying a strategic position at confluence the Amazon, Cerrado, and Caatinga domains; thus, the state presents several types of plant formations and the flora is highly diverse (Muniz 2006; Dias et al 2009). Although Marahnão exhibits floristic potential, few studies on Bromeliaceae and other families of plants in the state are available, as shown by recently published new occurrences (e.g. Ferreira et al. 2018; Guarçoni et al. 2018; Ferreira et al. 2019a, 2019b; Salazar-Ferreira et al. 2020; Silva et al. 2020) and new species (e.g. Scatigna et al. 2019; Guarçoni et al. 2020).

During recent fieldwork throughout Maranhão, we collected three species belonging to the family Bromeliaceae, *Encholirium spectabile* Mart. ex Schult. & Schult. f., *Pitcairnia burchellii* Mez, and *Tillandsia bulbosa* Hook. All were previously known only from other states in Brazil, and we report these three species for the first

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time from Maranhão (Flora do Brasil 2020). We include our new data, as well as comments on these species' morphology, taxonomy, and ecology.

Methods

Study location. The state of Maranhão, in northeastern Brazil, occupies an area of 331,983 km². The state's vegetation displays ecotonal characteristics due to its position between the Amazon (North Region of Brazil), Cerrado (Midwest Region), and Caatinga (Northeast Region) domains (Muniz 2006). The climate of Maranhão is Tropical Savânico Aw and Tropical Monçônico Am (Köppen 1948), with average annual temperature ranging between 22 and 27 °C and average annual precipitation between 800 and 2800 mm (Martins and Oliveira 2011). The dry period lasts from June to November or December when there is a water deficit of 150–300 mm, and the rainy period occurs between January and June, but more intense in February and March (IMESC 2008).

Data collection. We made field collections between June 2015 and December 2019. The specimens were herborized according to the methology of Fidalgo and Bononi (1989), and the voucher specimens have been incorporated in the BMA, INPA, SLUI, and UB herbaria (acronyms according to Thiers 2020). Author names of each species are in agreement with IPNI (2019).

The geographic distributions of the three species included here are in accordance with Flora do Brasil (2020) and SpeciesLink (2020). The map of the new records (Fig. 1) was created using QGIS v. 2.18.12 software (QGIS.org 2020), using SIRGAS 2000 data.

Results

***Encholirium spectabile* Mart. ex Schult. & Schult. f.**, *in* Syst. Veg., 7(2): 1233. (Roemer and Schultes 1830)
Figure 2A–C

New records. BRAZIL - Maranhão • V.P. Lima 6898 (INPA 205251, UB45-40-95); Carolina, na estrada Carolina-Estreito, na Pedra Caída; 07°02′S, 47°27′W; 3 Aug. 1993; fr. • E. Guarçoni 2342 & A.W.C. Ferreira (BMA 1042); Fortaleza dos Nogueiras, subida da Agrosserra; 06°52′50″S, 045°57′19″W; 6 Jun. 2015; fl.

Identification. *Herb* 1.1–2.0 m tall, rupicolous. *Leaves* ca 20, patents upright, curved at upper third portion; *sheath* elliptical, 2.8–4.7 × 3.5–5.9 cm, white, glabrous, margin entire; *blade* linear-triangular, 55.8–91.0 × 1.9–0.6 cm, green, cinereous on both faces, margin aculeate, aculeos green, ca 1.5–0.3 mm long, narrowing to apex. *Peduncle* erect, 47.0–57.5 cm long, green to brown, glabrous. *Peduncle bracts* medians exceeding internodes, lanceolate, 4.2–15.5 × 0.4–1.0 cm, vinaceous at base, cinereous or straw-like at apex, glabrous to sparingly lepidote margin aculeate, aculeus ca 1.5 mm long, apex attenuated. *Inflorescence* raceme 35.7–36.0 cm tall; *rachis*

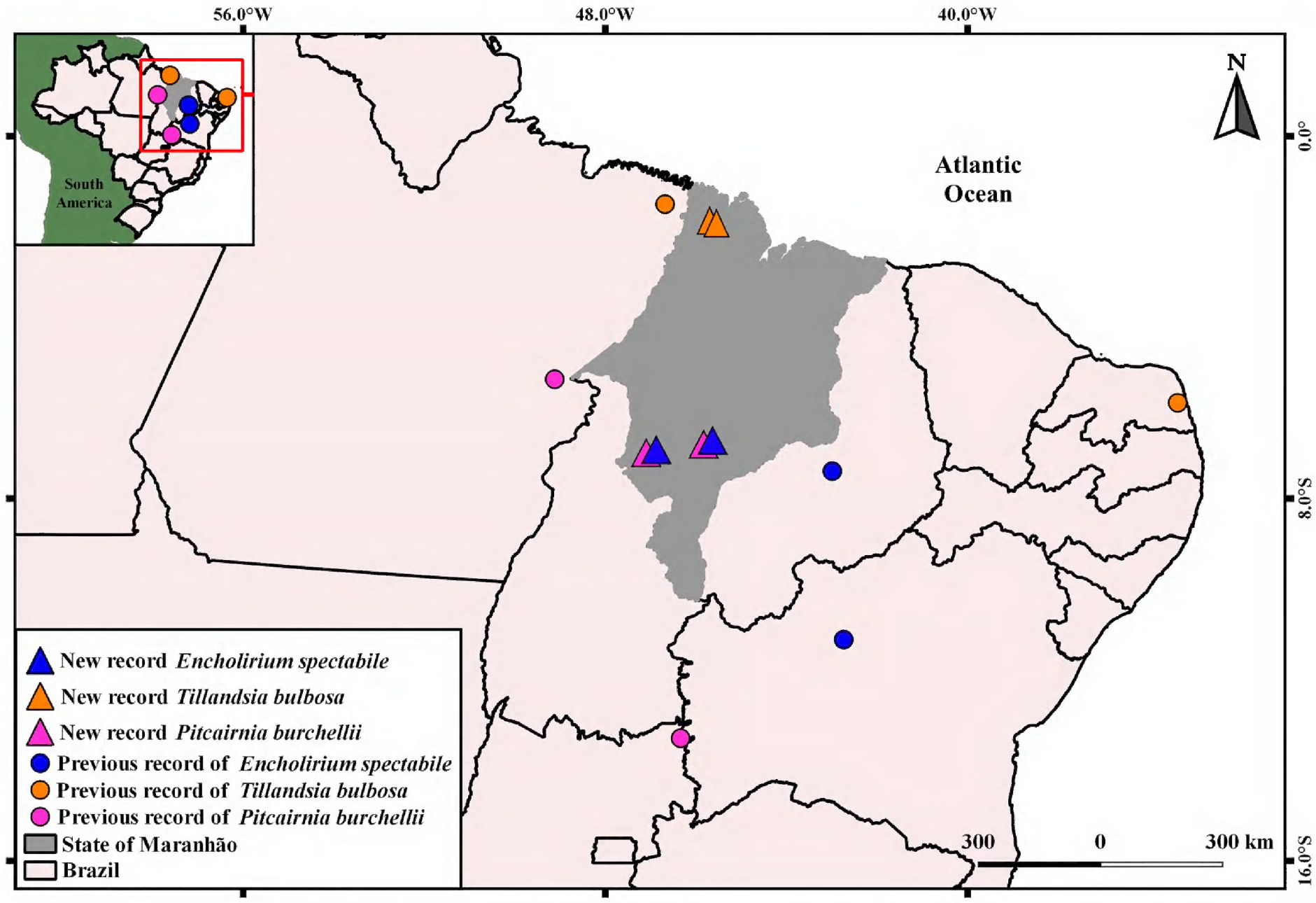

Figure 1. Geographic distribution of *Encholirium spectabile* Mart. ex Schult. & Schult. f. (blue triangle), *Pitcairnia burchellii* Mez (hot pink triangle) and *Tillandsia bulbosa* Hook. (orange triangle) in the state of Maranhão, Brazil.

Figure 2. New occurrences of Bromeliaceae from Maranhão. **A–C.** *Encholirium spectabile* Mart. ex Schult. & Schult. f.: (**A**) natural environment habit; (**B**) rosettes in bloom and fruiting; (**C**) details of the inflorescence. **D–F.** *Pitcairnia burchellii* Mez.: (**D**) in the natural environment at the Fortaleza dos Nogueiras city; (**E**) flowering plant habit in the of Carolina city, PARNA Chapada das Mesas; (**F**) flower detail. **G, H.** *Tillandsia bulbosa* Hook.: (**G**) plant in bloom in the Cândido Mende city; (**H**) details of the plant. (Photos: A–F: Elidio Guarçoni; G, H: Alessandro Ferreira).

green, glabrous. *Floral bract* oval-lanceolate, 0.3–0.5 × 0.1–0.2 cm, brown to blackish, glabrous, margin entire, apex attenuated. *Flowers* more than 50, pedicellate, patents, 1.7–2.1 cm long; *pedicel* 1.0–1.2 cm long, green to brown, glabrous; *sepals* ovals, 0.7–0.9 × 0.3–0.4 cm, green with apex vinaceous, glabrous, apex acute; *petals* elliptical, 1.6–1.8 × 0.4–1.0 cm, green or greenish-cream, glabrous, apex obtuse; *petal appendages* absent; *stamens* exserted, free, yellowish green; *filaments* 1.5–2.1 cm long; *anthers* linear, green, dorsifixed; *ovary* inferior, 0.7–1.3 cm long; *style* 1.4–1.7 cm long; *stigma* ca 0.9 mm, yellow. *Fruit* unknown.

***Pitcairnia burchellii* Mez**, Fl. Peruv. 3: 35. (Mez 1894)
Figure 2D–F

New records. BRASIL - Maranhão • E. Guarçoni et al. s/n. (BMA 2095); Carolina, National Park Chapada das Mesas, subida da Serra Grande; 06°55′53″S, 047°22′50″W; 15 Feb. 2019; fl. • E.O. Silva et al. 205 (SLUI 5813); Fortaleza dos Nogueiras, Cachoeira Recanto das Águias; 06°57′23″S, 046°00′11″W; 15 Jun. 2017; fl.

Identification. *Herb* 53.3–91.2 cm tall, terrestrial or saxicolous. *Leaves* ca 12, dimorphic, suberect; *sheath* ovate, 0.8–3.1 × 1.2–1.8 cm, green, white-lepidote abaxially, margin entire; *blade* linear, 48.2–87.6 × 1.7–2.0 cm, green, densely white-lepidote abaxially, glabrous adaxially, channeled, margin entire with aculeos at base, aculeos brown, ca 2 mm long, apex acute. *Peduncle* erect to suberect, 47.6–89.4 cm long, green, white-lanuginous. *Peduncle bracts* larger than internodes, linear, 16.0–25.8 × 0.5–0.7 cm, green, densely white-lepidote on abaxial face, glabrous on adaxial face, margin entire, apex acute. *Inflorescence* simple, 10–11.6 cm tall; *rachis* brown, white-lanuginous. *Floral bracts*, ovate, 2.7–5.8 × 2.7–3.4 mm, brown, white-lepidote on abaxial face, glabrous on adaxial face, margin entire, apex acute. *Flowers* 7–10, pedicellate, suberect, 4.9–5.3 cm long; *pedicel* 5.1–6.7 mm long, brown, white-tomentose; *sepals* linear, 1.7–1.8 × 0.5 cm, brown, densely white-tomentose, fimbriated, succulent, apex acute; *petals* linear, 4–4.5 × 0.4–0.5 cm, reddish-green, glabrous, presence of a pair of petal appendages, apex acute; *petal appendages* ovate, 2.1 mm long, yellow, truncated; *stamens* included, free, yellow; *filaments* ca 2 cm long; *anthers* oblong, yellow, dorsifixed; *ovary* superior, ca 6.3 mm long; *style* ca 2.7 cm long; *stigma* 2.2 mm long, yellow. *Fruit* capsule; *seeds* unknown.

Tillandsia bulbosa* Hook., *in Exot. Fl. 3: 173. (Hooker 1825)
Figure 2G, H

New records. BRAZIL - Maranhão • W.R. Silva-Júnior & A.W.C. Ferreira 206 (SLUI 5814); Cândido Mendes, Fazenda Sete Irmãos, igarapé Reno; 01°52′61″S, 045°45′33″W; 29 Jul. 2018; fl. • A.W.C. Ferreira 207 (SLUI 5815); rio Macaxeira; 01°52′47″S, 045°47′54″W; 20 Dec. 2019; fl.

Identification. *Herb* 10–18 cm tall, epiphyte. *Leaves* 8–14, arched to winding; *sheath* somewhat pentagonal when dry, 2.0–2.6 × 1.7–2.1 cm, green, cinereous-lepidote, margin entire; *blade* linear, 8.3–12.8 × 0.3–0.5 cm, green, sparsely lepidote on both faces, margin entire, apex attenuate. *Peduncle* incurved, 3–7 cm long, green, cinereous-lepidote. *Peduncle bracts* exceeding internodes, elliptic at base, 2.0–15.0 × 0.5–0.6 cm, green to rosaceous, involute-subulate towards apex, sparse-lepidote, margin entire, apex long acuninate. *Inflorescence* spike, 8–10 cm long; *rachis* green, glabrous. *Floral bracts* elliptical, 0.1–0.2 × 0.5–0.6 cm, green, lepidote, margin serrated, apex acute to acuminate. Flowers 3–6, sessile, suberect, 1.3–1.8 × 0.2–0.5 cm, congested; *pedicel* absent; s*epals* elliptical-oblong, 1.6–1.7 × 0.3–0.4 cm, purple, glabrous, subconate, apex acute; *petals* elliptical-lanceolate, ca 3.0 × 0.5 cm, purple, glabrous, apex subacute; *petal appendages* absent; *stamens* exserted, free, green; *filaments* ca 3.3 cm long, compressed; *anthers* linear, yellow, basifixed; *ovary* superior, 0.5 cm long; *style* 2.4–2.5 × 0.1 cm; *stigma* ca 0.1 cm long, green. *Fruit* capsular, 3.6–3.9 × 0.3 cm, cylindrical; *seeds* elongate, 0.2 cm long, dark brown, feathery appendages 2.0–2.5 cm long.

Discussion

Encholirium spectabile, described by Schultes & Schultes f. in 1830 (Smith and Downs 1974; Forzza 2001), displays a wide geographical distribution and high morphological variability which have contributed to the description of the extremes of its variations to be considered as distinct species (Forzza 2001). *Encholirium spectabile* is endemic to Brazil, found in the Caatinga, Cerrado, and Atlantic Forest domains, in the states of Goiás, Minas Gerais, Alagoas, Bahia, Ceará, Paraíba, Pernambuco, Piauí, Rio Grande do Norte, and Sergipe (Flora do Brasil 2020; SpeciesLink 2020). Our records of this species are the first occurrences of any species of *Encholirium* in Maranhão, which until now was the only state in northeastern Brazil where this genus had not been recorded (Flora do Brasil 2020). *Encholirium spectabile* has the largest geographic distribution in Brazil of any species of *Encholirium*; this species is found on rocky outcrops throughout almost all of northeastern Brazil, mainly in Caatinga areas, although it can also be found in the rocky fields of the mountain located north of the Cadeia do Espinhaço, in Bahia, and in Caatinga-Cerrado transition outcrops (Forzza 2001). The species is categorized as Least Concern according to International Union for the Conservation of Nature (IUCN) criteria (Romand-Monnier 2013).

At the sites where we found this species, it is rupicolous and saxicolous on outcrops of sedimentary rocks in the Cerrado domain, with a strong influence from the Amazon domain. We observed this species either isolated or forming clumps containing a few individuals. It was always a heliophile, blooming between June and

July. Our records of *E. spectabile* expand the geographic distribution of this species 338 km west of Sete Cidades (Piauí, Brazil) and 588 km north of São Inácio (Bahia, Brazil), the nearest previously known occurrences.

Pitcairnia burchellii is extremely similar to *Pitcairnia lanuginosa* Ruiz & Pav. and is considered a synonym (Smith and Downs 1974). However, despite its close resemblance, "*P. burchellii* is more robust than *P. lanuginosa*", which does not occur in Brazil (Saraiva 2013; Saraiva et al. 2015). *Pitcairnia burchellii* is endemic to Brazil, where it occurs in the Amazon, Atlantic Forest, Caatinga, and Cerrado domains. It presents one of the greatest distributions within the genus, occurring throughout the Cerrado domain, where it occurs in some outcrop areas in the North (Pará, Rondônia, Tocantins), Northeast (Alagoas), Midwest (Goiás, Mato Grosso do Sul, Mato Grosso) and Southeast (Minas Gerais) (Flora do Brasil 2020) regions.

Pitcairnia bruchellii is registered for the first time for Maranhão and has its second record for the northeast of Brazil; previously it has been recorded only in Alagoas but with possible occurrences in Bahia and Piaui (Flora do Brasil 2020). In Maranhão, we collected *P. burchellii* in the cities of Fortaleza dos Nogueiras and Carolina (Chapadas das Mesas National Park), always near the water in the rocky outcrops of the Cerrado domain. We found blooming during February and March. This species has not yet been evaluated by the IUCN (2020). Our records of *P. burchellii* expand its geographic distribution by 713 km north of São Domingos (Lapa river, Terra Ronca State Park, Goiás, Brazil) and 387 km east of Carajás (Serra North, N-1 ore exploration area, Marabá, Pará, Brazil).

Tillandsia bulbosa has a morphology distinctive from other species of its genus and can be easily recognized by its bulb-like rosettes. *Tillandsia bulbosa* is widely distributed, occurring from Mexico to Brazil. In Brazil it occurs in the Amazon and Atlantic domains, in the North (Amazonas, Amapá, Pará), Northeast (Alagoas, Bahia, Paraíba, Pernambuco, Rio Grande do Norte, Sergipe), and Southeast (Espírito Santo) regions (Flora of Brazil 2020). Our new records are the first occurrences from Maranhão (Flora of Brazil 2020). We found this species in the municipality of Cândido Mendes, in an area of Amazon domain area. It is an epiphyte, blooming between July and December.

Where we found *T. bulbosa*, specimens develop both in the crown and in the phorophyte stem of the forest fragment, near riverbanks and seasonal streams. It was common to find ants nesting among the dilated leaf sheaths of this bromeliad. Capuchin monkeys (*Sapajus* sp.) were observed feeding on the leaf bases of *T. bulbosa*. These associations have also been verified by Fiorato (2009) and (Benzing) 1990). Our new records of *T. bulbosa* extend the geographic distribution of this species by 88 km east of Viseu (Pará, Brazil) and 1,240 km west of Macaíba (Rio Grande do Norte, Brazil).

Acknowledgments

We thank FAPEMA (UNIVERSAL-00855/17) for funding our research, as well as the Chico Mendes Institute (ICMBIO 23683-6) and the State Secretariat of Environment of the Maranhão State, Biodiversity and Protected Areas Superintendence (SBAP 0203724/2015) for the granting of collection licenses. AWFC thanks FAPEMA (UNIVERSAL-0040/2015). We also acknowledge the anonymous reviewers who made valuable suggestions to improve the manuscript.

Authors' Contributions

EAEG collected and identified part of the material, reviewed the manuscript, prepared the figures and is responsible for the project. JDSS collected, helped with the identification of the material and was responsible for writing the manuscript. AWCF collected and identified some of the material and revised the article. MSO collected part of the material, revised the article and prepared the map. WRSJ collected and identified part of the material and revised the manuscript. EOS collected some of the material and revised the manuscript.

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